Candid Voices

Looking at the Best Way to Get There: Comparing the Cost Effectiveness of Two Means in Moving Aircraft Spares

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Background

During their 8 December 2001 meeting, the Strategic Distribution Management Initiative (SDMI) Board of Directors raised the issue of the Air Force's frequent use of premium transportation versus the use of SDMI transportation from its air logistics centers. SDMI was established to better streamline Department of Defense distribution and logistics. SDMI, now known as Strategic Distribution (SD), is a joint venture between United States Transportation Command and the Defense Logistics Agency (DLA).

In response to those issues, the Air Force Logistics Management Agency (AFLMA) completed a project entitled, *Review and Analysis of the Air Force's Use of Premium Transportation* (LT200135100) in July 2002. In that study, AFLMA compared the transportation and inventory costs of moving all Air Force-managed reparables using the cheapest available transportation option to the costs of using Worldwide Express (WWX) transportation options, which are faster but more expensive. The study concluded that WWX transportation is still more cost-effective than traditional *slow* transportation when moving Air Force-managed reparables.

Subsequently, the Air Force Directorate of Logistics Readiness (AF/ILG) tasked AFLMA to examine the cost-and-ship-time difference between WWX and SD-managed transportation and

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Acronyms

AFLMA - Air Force Logistics Management Agency
AMC - Air Mobility Command
APOE - Aerial Port of Embarkation
CONUS - Continental United States
DLA - Defense Logistics Agency
FY - Fiscal Year
OCONUS - Outside the Continental United States
SD - Strategic Distribution
SDMI - Strategic Distribution Management Initiative
USEUCOM - United States European Command
USPACOM - United States Pacific Command
WWX - Worldwide Express

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to limit the study to Air Force-managed reparables going from the continental United States (CONUS) to locations outside the continental United States (OCONUS). This was done to give a better comparison between SD and WWX in the movement of reparables. AFLMA was tasked to examine two specific routes from CONUS to OCONUS that would represent all CONUS to OCONUS traffic. This study was completed to comply with AF/ILG's direction.

With this direction, an analysis was conducted to determine, from a cost perspective, if SD is a viable alternative to WWX in the movement of reparables from air logistics centers to overseas locations.

Research Methodology

The study was completed in three areas of analysis. First was the transportation cost analysis portion. The following steps were taken to analyze the cost difference between WWX and Air Mobility Command (AMC) SD.

- Identify a few selected routes to use as representative of all traffic from CONUS to each of the OCONUS regions.
- Identify a few shipment weights to use as representative of the weight of every shipment.
- Determine AMC's rate for each of the routes and each of the shipments.
- Find the average WWX rate for each of the routes and each of the shipments.
- Find the total weight of material shipped out of Air Force depots.
- Determine the percentage of material shipped to each of the OCONUS regions.
- Determine the percentage of total material to be represented by each of the shipment weights.
- Determine the total weight of material moved into each region, by shipment weight.
- Determine the total cost to move these shipments via both WWX and AMC/SD.
- Determine cost difference between WWX and AMC/SD.

Second, we analyzed the shipping time of reparable items through the two different means compared in this study. We

obtained AMC shipping time data and the average ship time for the high-priority shipments. The shipping time was calculated, using a 2-day estimated ship time from Tinker Air Force Base, Oklahoma, to the aerial ports of embarkation (APOE). Then, the difference between the WWX shipping time and the AMC/SD shipping time for each theater was calculated.

Finally, the ship-time difference was inserted into the Aircraft Availability Model and the change in inventory cost to use SD versus WWX was determined.

Transportation Cost Analysis

We estimated the cost of moving Air Force-managed reparable items from CONUS to OCONUS by using the costs for a single, notional route from Tinker to an OCONUS location in each theater, then extending the costs for this route to all CONUS to OCONUS Air Force-managed reparable traffic.

The first step was to estimate the costs for individual shipments. Given the time constraints of the study, we built a table of cost differences for a few shipments (described by weight) moving on the selected route for each theater. The route for the European theater was from Tinker to Aviano Air Base (AB), Italy. The route for the Pacific theater was from Tinker to Kadena AB, Japan. The SD route for the United States European Command (USEUCOM) was a scheduled truck from Tinker to Dover AFB, Delaware then AMC airlift to Ramstein AB, Germany; then shipped via either truck or air to Aviano. The SD route for the United States Pacific Command (USPACOM) was a scheduled truck from Tinker to Travis AFB, California; then AMC airlift to Kadena. Table 1 shows the costs for each shipment weight. For USEUCOM and USPACOM columns, the numbers are the differences between the average of the three WWX carrier rates and the rate SD charged from Tinker to the final destination. The SD is simply the weight of the shipment times the rate ($1.69 per pound to Kadena—$1.71 per pound to Aviano).

The estimated cost difference for the different shipment weights is shown in Table 2. A positive value indicates the WWX rate was more expensive than the AMC/SD rate, while a negative value in the table indicates the AMC/SD rate was greater than the WWX rate. It is important to note three things about the SD rates used in this study. First, the rates used in this study were significantly less than the published rates ($1.69 per pound versus $2.74 per pound to Kadena and $1.71 per pound versus $2.13 per pound to Aviano). Second, these low rates included the cost for fast shipment (guaranteed 2-day trucking) from origin to destination in the CONUS. Finally, the rates included the cost for intratheater shipping in the OCONUS regions as well. All three of these assumptions favor the SD option. These rates were provided by US Transportation Command specifically for this study and were based on the assumption that, if the SD option were used, traffic would increase along the specified routes, thereby resulting in lower SD rates.

The next step was to estimate the distribution of shipments by weight. RAND sent the AFLMA data on Air Force shipments moved during fiscal year (FY) 01, including shipment weight. To estimate the weight distribution of shipments of Air Force-managed items, AFLMA filtered out all the shipments not originating from an Air Force depot. Every shipment was put into one of the weight categories shown in Table 2. The percentage of shipments for each category, by theater, is shown in Table 3.

Next, using readiness-based leveling data, we determined the total number of outbound shipments of Air Force-managed items moved to the various theaters from the air logistics centers (excluding lateral support and retrograde shipments) during FY01. This information is shown in Table 4.

Finally, to estimate the upper bound on the total savings if all Air Force-managed items were shipped via routine transportation instead of premium commercial transportation, we made the following assumptions.

- All the items shown in Table 4 were moved using premium transportation
- The transportation savings for all shipments weighing between 0 and 10 pounds were approximated using the savings for a 10-pound shipment, shipments between 11 and 20 pounds were approximated using the savings for a 20-pound shipment, and so on. This process overstated the transportation savings because very few of the shipments weighed exactly the amount used in the calculation. A very large majority weighed less than 10 pounds, and the savings for a 5-pound shipment would be less than for a 10-pound shipment since transportation charges are based on exact weight, and not on weight-range categories

Given these assumptions, to estimate an upper bound on transportation savings, we multiplied the number of shipments moved in a theater (Table 4) by the percentage of those shipments weighing a certain number of pounds (Table 3). We then multiplied that number by the savings per shipment for that type of item (Table 2). The final results are shown in Table 5. A positive

Weight	WWX		AMC/SD	
	EUCOM	PACOM	EUCOM	PACOM
0-10 lbs	$25.08	$25.30	$17.10	$16.90
11-20 lbs	$40.16	$40.85	$34.20	$33.80
21-30 lbs	$59.01	$57.61	$51.30	$50.70
31-40 lbs	$70.00	$68.26	$68.40	$67.60
41-50 lbs	$80.99	$83.67	$85.50	$84.50
51-60 lbs	$96.63	$98.50	$102.60	$101.40
61-70 lbs	$107.50	$107.32	$119.70	$118.30
70-80 lbs	$122.69	$117.83	$136.80	$135.20
81-90 lbs	$139.77	$139.68	$153.90	$152.10
91-100 lbs	$165.97	$170.14	$171.00	$169.00
101-110 lbs	$183.28	$187.98	$188.10	$185.90
111-120 lbs	$200.59	$205.82	$205.20	$202.80
121-130 lbs	$217.89	$223.65	$222.30	$219.70
131-140 lbs	$235.20	$241.49	$239.40	$236.60
141-150 lbs	$252.51	$259.33	$256.50	$253.50

Table 1. Costs per Shipment
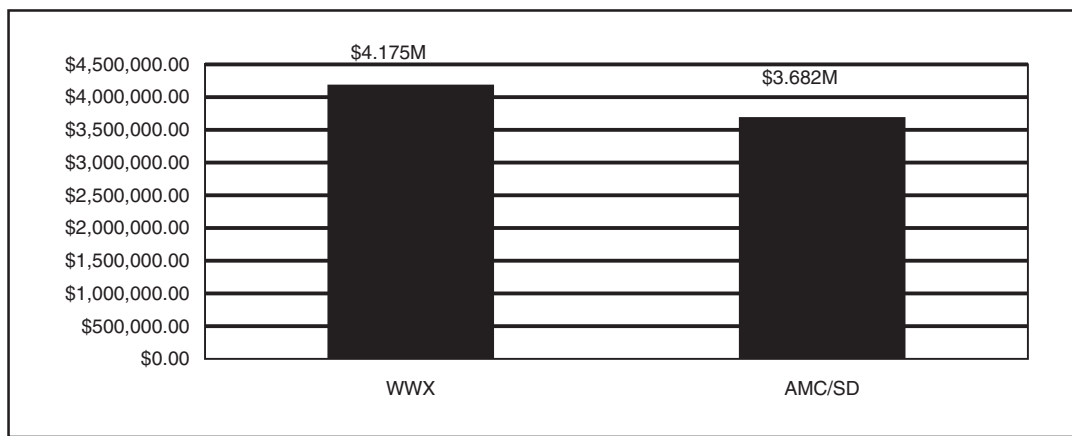
Figure 1. Comparison of Transportation Costs

To determine total estimated transportation costs, we multiplied the number of shipments moved to a theater (Table 3) by the percentage of those shipments weighing a certain number of pounds (Table 2). We then multiplied that number by the cost per shipment (Table 1). Table 6 shows the total cost for both theaters for WWX and AMC/SD. Table 7 shows the estimated annual total cost for moving reparables via WWX and AMC/SD overseas. Figure 1 compares the costs graphically.

Weight	EUCOM	PACOM
0-10 lbs	$7.98	$8.40
11-20 lbs	$5.96	$7.05
21-30 lbs	$7.71	$6.91
31-40 lbs	$1.60	$0.66
41-50 lbs	-$4.51	-$0.83
51-60 lbs	-$5.97	-$2.90
61-70 lbs	-$12.20	-$10.98
70-80 lbs	-$14.11	-$17.37
81-90 lbs	-$14.13	-$12.42
91-100 lbs	-$5.03	$1.14
101-110 lbs	-$4.82	$2.08
111-120 lbs	-$4.61	$3.02
121-130 lbs	-$4.41	$3.95
131-140 lbs	-$4.20	$4.89
141-150 lbs	-$3.99	$5.83

Table 2. Transportation Cost Difference for Individual Shipments

Weight	EUCOM	PACOM
0-10 lbs	57.47%	54.84%
11-20 lbs	11.16%	12.00%
21-30 lbs	7.00%	7.39%
31-40 lbs	4.30%	4.18%
41-50 lbs	2.45%	2.67%
51-60 lbs	1.89%	1.64%
61-70 lbs	1.46%	1.89%
70-80 lbs	2.22%	1.53%
81-90 lbs	1.18%	1.07%
91-100 lbs	1.41%	0.85%
101-110 lbs	1.41%	1.00%
111-120 lbs	0.56%	0.57%
121-130 lbs	0.23%	0.67%
131-140 lbs	0.18%	0.46%
141-150 lbs	0.56%	0.32%

Table 3. Percentage of Air Force Shipments by Weight Category and Theater

	EUCOM Number	PACOM Number
Items Moved	41840	54121

Table 4. Number of Shipments Moved

value shows using WWX would be more expensive than AMC/SD, while a negative value indicates AMC/SD would be more expensive than WWX. The maximum potential transportation savings for using AMC/SD versus WWX would have been $493,615.

Ship-Time Analysis

The next portion of the analysis compared the ship time of WWX to the SD system. We analyzed WWX shipments for October 2001 from Oklahoma City Air Logistics Center, to Aviano (130 shipments) and Kadena (63 shipments). We also analyzed AMC shipments for October 2001 – December 2001 from Travis to Kadena (3,006 shipments) and Dover to Aviano (1,562 shipments). For the AMC routing, we included only shipments with a transportation priority of 1 or 2 and an air special handling code of Z, meaning no special handling was required. This was done to ensure the most accurate comparison possible between WWX and AMC/SD. AMC shipments meeting these criteria were most like WWX shipments.

For the shipments described above, we found the mean shipment time. For the WWX shipments, we calculated the mean days from when the shipment was picked up to when it was delivered. For the AMC shipments, we found the mean days from when the shipment arrived at the APOE to when it arrived at the

Weight	EUCOM	PACOM
0-10 lbs	$191.822.68	$249,311.63
11-20 lbs	$27,829.29	$45,786.37
21-30 lbs	$22,581.05	$27,636.83
31-40 lbs	$2,878.59	$1,493.09
41-50 lbs	-$4,623.11	-$1.199.38
51-60 lbs	-$4,720.93	-$2,573.99
61-70 lbs	-$7,452.54	-$11.231.30
70-80 lbs	-$13,106.05	-$14,383.25
81-90 lbs	-$6,976.15	-$7,192.36
91-100 lbs	-$2,967.42	$524.43
101-110 lbs	-$2,843.53	$1,125.72
111-120 lbs	-$1,080.14	$931.64
121-130 lbs	-$424.38	$1,432.31
131-140 lbs	-$316.31	$1,217.40
141-150 lbs	-$934.87	$1,009.68
Theater Transportation Cost Difference	$199,726.17	$293,888.83
Total Transportation Cost Difference	$493,615.00	

Table 5. Total Transportation Cost Difference

	WWX		AMC/SD	
Weight	EUCOM	PACOM	EUCOM	PACOM
0-10 lbs	$603,060	$750,903	$411,177	$501,591
11-20 lbs	$187,521	$265,301	$159,692	$219,515
21-30 lbs	$172,828	$230,414	$150,247	$202,777
31-40 lbs	$125,938	$154,422	$123,060	$152,929
41-50 lbs	$83,021	$120,906	$87,644	$122,105
51-60 lbs	$76,413	$87,427	$81,134	$90,001
61-70 lbs	$65,668	$109,776	$73,120	$121,008
70-80 lbs	$113,960	$97,569	$127,066	$111,953
81-90 lbs	$69,006	$80,888	475,982	$88,080
91-100 lbs	$97,913	$78,269	$100,880	$77,745
101-110 lbs	$108,125	$101,737	$110,968	$100,611
111-120 lbs	$46,999	$63,493	$48,079	$62,562
121-130 lbs	$20,968	$81,098	$21,392	$79,666
131-140 lbs	$17,713	$60,121	$18,030	$58,903
141-150 lbs	$59,164	$44,913	$60,009	$43,903
Total	$1,848,298	$2,327,236	$1,648,572	$2,033,347

Table 6. Total Estimated Transportation Costs by Theater and Weight

WWX	AMC/SD
$4,175,534.22	$3,681,919.23

Table 7. Total Estimated Costs

	WWX	AMC/SD
EUCOM	3.53 days	7.47 days
PACOM	3.61 days	4.49 days

Table 8. Ship Times

final destination. We then added 2 days to the shipment time to represent the trucking time from Tinker to either Dover or Travis. The results are shown in Table 8. USEUCOM represents shipments to Aviano, while USPACOM represents shipments to Kadena.

Inventory Cost Analysis

Assuming the order time for an item remained constant, we applied the ship-time difference between WWX and SD to determine the impact on inventory. To determine the cost impact on inventory, we assumed that the times for the routes were representative of ship time for all routes in the respective theaters. We then weighted the ship-time increase for each theater by the percentage of worldwide shipments to each of those theaters to determine the impact on worldwide ship time. Shipments to USEUCOM represented 6.4 percent of all shipments, while 8.3 percent of the shipments were to USPACOM. We multiplied the percentage of shipments to a specific theater by the increase in ship time (USEUCOM: 0.064 X 3.94 days = 0.253; USPACOM: 0.083 X 0.88 days = 0.073). We then summed the times, with 0 representing CONUS (0.253 + 0.073 + 0 = 0.326, rounded to 0.33).

Therefore, using AMC/SD would result in a worldwide increase in ship time of 0.33 days. We used March 20, 2001 data from the Aircraft Availability Model (provided by the Logistics Management Institute) to estimate the impact of the increased worldwide ship time on the Air Force's reparable inventory. We estimated the 0.33-day increase in ship time for reparables from the ALCs would require an additional $7,679,721 in reparable inventory.

Using SD could save the Air Force $493,615 in transportation costs annually. However, ensuring no degradation in service would require an additional $7.68M in reparable inventory. Even with $493,615 in cost savings, it would take 15.67 years for the transportation cost savings realized by using AMC/SD to pay for the additional reparable inventory needed to maintain current levels of service.

Conclusion

Based on the analysis, SD was shown to be less expensive when looking at strictly transportation costs. However, even with lower transportation costs, SD is not cost effective. The reason for this is reparable inventories would have to increase, meaning additional inventory would have to be bought and maintained to overcome the slower ship time of SD versus the ship time of WWX. Therefore, SD is not a viable alternative to WWX for moving eligible reparables from air logistics centers to overseas locations.

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notable quotes

Army officers are intelligent—give them the bare tree, let them supply the leaves.

—**Gen George C. Marshall**